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(54) EXHAUST EMISSION CONTROL SYSTEM AND EXHAUST EMISSION CONTROL METHOD

(57)Abstract:

PROBLEM TO BE SOLVED: To provide an exhaust emission control system capable of removing a noxious material from exhaust gas without heating the noxious material.

SOLUTION: An exhaust gas flow passage 3 is provided with a discharge plasma reaction part 4 and a nitrogen oxide reduction catalyst 8. The discharge plasma reaction part 41 is provided with a filter structural element 7. Meanwhile, a power source 6 for generating discharge plasma is connected to the discharge plasma reaction part 4, and an electrical field is generated at the discharge plasma reaction part 4 and discharge plasma is generated. A particulate material contained in exhaust gas is captured by the particulate material capturing function and the electric dust arresting function, accompanied with formation of an electric field, of the filter structure element 7, and the captured particulate material is combustion-treated by the action of discharge plasma to regenerate the function of the filter. Further, a nitrogen oxide contained in exhaust gas X is oxidized and meanwhile, a given chemical species are produced, the nitrogen oxide contained in exhaust gas is reduced through reduction decomposition reaction of the nitrogen oxide by the produced chemical specifies and a nitrogen oxide reduction catalyst 8.

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CLAIMS

[Claim(s)]
[Claim 1]
The discharge plasma reaction section and a nitrogen-oxides reduction catalyst are prepared in the emission way of the exhaust gas discharged from the engine. In said discharge plasma reaction section, the filter structure which has a particulate matter prehension function While being prepared possible [passage of said exhaust gas], the power source for discharge plasma generating is connected to said discharge plasma reaction section. The discharge plasma is generated, while this power source for discharge plasma generating controls either [at least] an output frequency or output voltage based on an input signal and forming electric field in said discharge plasma reaction section. The particulate matter contained in said exhaust gas is caught by the particulate matter prehension function of said filter structure, and the electrostatic precipitation-function accompanying formation of electric field. While combustion processing of the caught particulate matter is carried out by operation of said discharge plasma and the particulate matter prehension function of said filter structure is reproduced While the nitrogen oxides contained in said exhaust gas oxidize, necessary chemical species are generated. The emission-gas-purification system characterized by constituting so that the nitrogen oxides contained in said exhaust gas by carrying out reductive cleavage of the nitrogen oxides according to the generated chemical species and said nitrogen-oxides reduction catalyst may be reduced.
[Claim 2]
for the power source for discharge plasma generating, said input signal be the emission gas purification system according to claim 1 which characterize by constitute so that the discharge power per unit flow rate of said exhaust gas control to the discharge power which become comparable as the amount of NO(s) before the amount of nitrogen monoxide (NO) reduction which be the nitrogen oxides in said discharge plasma reaction section decrease including the flow rate of said exhaust gas.
[Claim 3]
it be the emission gas purification system according to claim 1 which said input signal calculate the flow rate of said exhaust gas from this engine speed including the engine speed of said engine, and characterize by constitute the power source for discharge plasma generating so that the discharge power per the unit flow rate of said exhaust gas control to the discharge power which become comparable as the amount of NOs before the amount of nitrogen monoxide (NO) reduction which be the nitrogen oxides in said discharge plasma reaction section decrease.
[Claim 4]
Said input signal is an emission-gas-purification system according to claim 1 characterized by to constitute the increment in discharge power so that it may control to reduce control or discharge power when the amount of reduction of nitrogen oxides becomes the temperature of the exhaust gas which does not increase enough , even if the temperature of said exhaust gas increases the power source for discharge plasma generating including the temperature of said exhaust gas and it makes discharge power increase .
[Claim 5]
Said input signal contains at least the engine speed of said engine, and one side of an engine torque. The temperature of said exhaust gas is searched for from said input signal. Even if the temperature of said exhaust gas increases and it makes discharge power increase, when the amount of reduction of nitrogen oxides becomes the temperature of the exhaust gas which does not increase enough, the power source for discharge plasma generating the increment in discharge power so that control or discharge power may be reduced The emission-gas-purification system according to claim 1 characterized by constituting so that it may control.

[Claim 6]
The power source for discharge plasma generating is an emission-gas-purification system according to claim 1 characterized by constituting so that it may control to discharge power which becomes comparable as the amount of the nitrogen monoxide before the amount of reduction of the nitrogen monoxide contained in said exhaust gas decreasing including the amount of the nitrogen monoxide (NO) with which said input signal is included in said exhaust gas.
[Claim 7]
it be the emission gas purification system according to claim 1 which said input signal be make into the amount of hydrocarbons contain in said exhaust gas, and be characterize by constitute the power source for discharge plasma generating so that it control to discharge power which become comparable as the amount of NO(s) before the amount of nitrogen monoxide (NO) reduction which be the nitrogen oxides in said discharge plasma reaction section decrease in the case of said amount of hydrocarbons.
[Claim 8]
it be the emission gas purification system according to claim 1 which said input signal calculate the amount of hydrocarbons contain in said exhaust gas from this air-fuel ratio including the air-fuel ratio of said engine, and be characterize by constitute the power source for discharge plasma generating so that it control to the discharge power which become comparable as the amount of NOs before the amount of nitrogen monoxide (NO) reduction which be the nitrogen oxides in said discharge plasma reaction section decrease in the case of said amount of hydrocarbons.
[Claim 9]
the power source for discharge plasma generating be an emission gas purification system according to claim 1 characterize by constitute so that it may control to discharge power which become comparable as the amount of NO(s) before the amount of nitrogen monoxide (NO) reduction which be the nitrogen oxides in said discharge plasma reaction section decrease including the amount of the nitrogen oxides with which said input signal be include in said exhaust gas.
[Claim 10]
it be the emission gas purification system according to claim 1 which said input signal calculate the amount of the nitrogen oxides contain in said exhaust gas from said input signal including at least the engine speed of said engine, and one side of an engine torque, and be characterize by constitute the power source for discharge plasma generating so that it control to the discharge power which become comparable as the amount of NOs before the amount of nitrogen monoxide (NO) reduction which be the nitrogen oxides in said discharge plasma reaction section decrease.
[Claim 11]
The step which prepares the filter structure which has a particulate matter prehension function, and a nitrogen-oxides reduction catalyst in the emission way of the exhaust gas discharged from the engine, The step which generates the discharge plasma while controlling either [at least] an output frequency or output voltage based on an input signal and forming electric field in the interior of said filter structure, The step which catches the particulate matter contained in said exhaust gas by the particulate matter prehension function of said filter structure, and the electrostatic precipitation-function accompanying formation of electric field, The step which combustion processing of the caught particulate matter is carried out [step] according to an operation of said discharge plasma, and reproduces the particulate matter prehension function of said filter structure, The step which generates necessary chemical species while oxidizing the nitrogen oxides contained in said exhaust gas by operation of said discharge plasma, The emission-gas-purification approach characterized by having the step which reduces the nitrogen oxides contained in said exhaust gas by carrying out reductive cleavage of the nitrogen oxides according to the generated chemical species and said nitrogen-oxides reduction catalyst.
[Claim 12]
said input signal be the emission gas purification approach according to claim 11 characterize by control the discharge power per unit flow rate of said exhaust gas including the flow rate of said exhaust gas to discharge power which become comparable as the amount of NO(s) before the amount of nitrogen monoxide (NO) reduction which be the nitrogen oxides in said discharge plasma reaction section decrease.
[Claim 13]
said input signal be the emission gas purification approach according to claim 11 characterize by calculate the flow rate of said exhaust gas from this engine speed, and control the discharge power per unit flow rate of said exhaust gas including the engine speed of said engine to discharge power which become comparable as the amount of NO(s) before the amount of nitrogen monoxide (NO) reduction which be the nitrogen

oxides in said discharge plasma reaction section decrease.

[Claim 14]

Said input signal is the emission-gas-purification approach according to claim 11 characterized by controlling the increment in discharge power to reduce control or discharge power when the amount of reduction of nitrogen oxides becomes the temperature of the exhaust gas which does not increase enough, even if the temperature of said exhaust gas increases and it makes discharge power increase including the temperature of said exhaust gas.

[Claim 15]

Said input signal is the emission-gas-purification approach according to claim 11 characterized by controlling the increment in discharge power to reduce control or discharge power when the amount of reduction of nitrogen oxides becomes the temperature of the exhaust gas which does not increase enough, even if it searches for the temperature of said exhaust gas from said input signal, the temperature of said exhaust gas increases including at least the engine speed of said engine, and one side of an engine torque and it makes discharge power increase.

[Claim 16]

Said input signal is the emission-gas-purification approach according to claim 11 characterized by controlling to discharge power which becomes comparable as the amount of the nitrogen monoxide before the amount of reduction of the nitrogen monoxide contained in said exhaust gas decreasing including the amount of the nitrogen monoxide (NO) contained in said exhaust gas.

[Claim 17]

said input signal be the emission gas purification approach according to claim 11 which be make into the amount of hydrocarbons contain in said exhaust gas, and be characterize by control to discharge power which become comparable as the amount of NO(s) before the amount of nitrogen monoxide (NO) reduction which be the nitrogen oxides in said discharge plasma reaction section decrease in the case of said amount of hydrocarbons.

[Claim 18]

said input signal be the emission gas purification approach according to claim 11 which calculate the amount of hydrocarbons contain in said exhaust gas from this air-fuel ratio, and be characterize by control to discharge power which become comparable as the amount of NO(s) before the amount of nitrogen monoxide (NO) reduction which be the nitrogen oxides in said discharge plasma reaction section decrease in the case of the calculated amount of hydrocarbons including the air-fuel ratio of said engine.

[Claim 19]

Said input signal is the emission-gas-purification approach according to claim 11 characterized by controlling including the amount of the nitrogen oxides contained in said exhaust gas to discharge power which becomes comparable as the amount of NO(s) before the amount of nitrogen-monoxide (NO) reduction which is the nitrogen oxides in said discharge plasma reaction section decreasing.

[Claim 20]

said input signal be the emission gas purification approach according to claim 11 characterize by control to discharge power which become comparable as the amount of NO(s) before calculate the amount of the nitrogen oxides contain in said exhaust gas from said input signal including at least the engine speed of said engine, and one side of an engine torque, and the amount of nitrogen monoxide (NO) reduction which be the nitrogen oxides in said discharge plasma reaction section decrease.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]
This invention is discharged from the engine used for cars, such as an automobile, and relates to the emission-gas-purification system and the emission-gas-purification approach of removing and purifying harmful matter from the exhaust gas containing harmful matter, such as particulate matter and nitrogen oxides.
[0002]
[Description of the Prior Art]
There are the following as an exhaust gas purge for purifying harmful matter, such as particulate matter (PM;Particulate Matter) and nitrogen oxides (NOx), conventionally from the exhaust gas discharged from exhaust gas generation sources, such as an engine.
[0003]
As a conventional exhaust gas purge for removing PM, PM filter is prepared in the gas passageway of the exhaust gas containing PM, and there is equipment which catches PM with this PM filter. And combustion removal of the matter, such as carbon contained in PM caught by PM filter, is carried out at a heating heater, and the function of PM filter is reproduced (for example, patent reference 1 reference).
[0004]
On the other hand, as a conventional exhaust gas purge for removing NOx, the three way component catalyst which understands NOx a returned part is formed in the gas passageway of the exhaust gas containing NOx, and there is equipment constituted so that it might understand a returned part. Noble metals, such as Pt, are supported by this three way component catalyst for activation (for example, patent reference 2 reference).
[0005]
[Patent reference 1]
JP,11-062558,A (3rd page - the 5th page, drawing 1)
[0006]
[Patent reference 2]
JP,2002-045701,A (3rd page - the 4th page, drawing 1)
[0007]
[Problem(s) to be Solved by the Invention]
In the exhaust gas purge from which the conventional PM is removed, in order for a combustion reaction with oxygen to remove matter, such as carbon contained in PM caught by PM filter, it is necessary to heat so that the temperature of gas may become about 600 degrees C.
[0008]
On the other hand, in the conventional exhaust gas purge from which NOx is removed, the operating temperature of a reduction catalyst is usually 300 degrees C or more, and the activity of a catalyst has low exhaust gas temperature in a temperature region 300 degrees C or less, and it cannot perform decomposition by reduction of sufficient NOx.
[0009]
Therefore, extention of the source of a heat tracing heater for heating exhaust gas also in which exhaust gas purge is needed, and conversely, when exhaust gas temperature is low temperature (especially 200 degrees C or less), PM or NOx cannot be removed efficiently.
[0010]

Furthermore, since the amount of NOx and PM which are contained in the amount of the exhaust gas discharged from the engine used for cars, such as an automobile, or exhaust gas is continuously changed according to transit conditions or a service condition, to purify NOx and PM efficiently according to fluctuation is desired.

[0011]

This invention is made in order to cope with this conventional situation, from the engine used for cars, such as an automobile, according to a service condition, is changed and is discharged, and it removes more efficiently and cheaply at low temperature, without heating harmful matter from the exhaust gas containing harmful matter, such as particulate matter and nitrogen oxides, and aims at offering the emission-gas-purification system and the emission-gas-purification approach of purifying exhaust gas.

[0012]

[Means for Solving the Problem]

In order to attain the above-mentioned purpose, the emission-gas-purification system concerning this invention As indicated to claim 1, the discharge plasma reaction section and a nitrogen-oxides reduction catalyst are prepared in the emission way of the exhaust gas discharged from the engine. In said discharge plasma reaction section, the filter structure which has a particulate matter prehension function While being prepared possible [passage of said exhaust gas], the power source for discharge plasma generating is connected to said discharge plasma reaction section. The discharge plasma is generated, while this power source for discharge plasma generating controls either [at least] an output frequency or output voltage based on an input signal and forming electric field in said discharge plasma reaction section. The particulate matter contained in said exhaust gas is caught by the particulate matter prehension function of said filter structure, and the electrostatic precipitation-function accompanying formation of electric field. While combustion processing of the caught particulate matter is carried out by operation of said discharge plasma and the particulate matter prehension function of said filter structure is reproduced While the nitrogen oxides contained in said exhaust gas oxidize, necessary chemical species are generated. It is characterized by constituting so that the nitrogen oxides contained in said exhaust gas may be reduced by carrying out reductive cleavage of the nitrogen oxides according to the generated chemical species and said nitrogen-oxides reduction catalyst.

[0013]

Moreover, in order to attain the above-mentioned purpose, the emission-gas-purification approach concerning this invention The step which prepares the filter structure which has a particulate matter prehension function, and a nitrogen-oxides reduction catalyst in the emission way of the exhaust gas discharged from the engine as indicated to claim 11, The step which generates the discharge plasma while controlling either [at least] an output frequency or output voltage based on an input signal and forming electric field in the interior of said filter structure, The step which catches the particulate matter contained in said exhaust gas by the particulate matter prehension function of said filter structure, and the electrostatic precipitation-function accompanying formation of electric field, The step which combustion processing of the caught particulate matter is carried out [step] according to an operation of said discharge plasma, and reproduces the particulate matter prehension function of said filter structure, The step which generates necessary chemical species while oxidizing the nitrogen oxides contained in said exhaust gas by operation of said discharge plasma, It is the approach characterized by having the step which reduces the nitrogen oxides contained in said exhaust gas by carrying out reductive cleavage of the nitrogen oxides according to the generated chemical species and said nitrogen-oxides reduction catalyst.

[0014]

[Embodiment of the Invention]

The gestalt of operation of the emission-gas-purification system concerning this invention and the emission-gas-purification approach is explained with reference to an accompanying drawing.

[0015]

Drawing 1 is the block diagram showing the gestalt of operation of the emission-gas-purification system concerning this invention.

[0016]

The emission-gas-purification system 1 is the configuration of having formed the discharge plasma reaction section 4 and the NOx reduction catalyst section 5 from the upstream at the serial on the exhaust gas pipe 3 as an example of the emission way where exhaust gas X discharged from the engine 2 used for sources of power, such as an automobile, flows, and having connected the power source 6 for discharge plasma generating to the discharge plasma reaction section 4 further.

[0017]
As an example of an engine 2, the diesel power plant for a generation of electrical energy carried in mobiles, such as mounted diesel power plants, such as car motor, a generator drive prime mover for cars, and a prime mover for vessel promotion, and a gasoline engine, a car, a vessel, and an aircraft, and a gasoline engine, the fixed mold diesel power plant used for a cogeneration (thermoelectrical supply) system or a generation-of-electrical-energy system, and a gas engine (gas motor) are mentioned, for example.
[0018]
And exhaust gas X which fuel oils, such as fuel oil A and C fuel oil, gas oil, a gasoline, town gas, methane, and a propane are used for these engines 2 as a fuel, and contains particulate matter (PM;Particulate Matter) and NOx is discharged.
[0019]
Moreover, the filter structure 7 is formed in the interior of the discharge plasma reaction section 4. This filter structure 7 is constituted so that exhaust gas X can flow that interior, and it has the particulate matter prehension function which catches PM which is the harmful matter contained in exhaust gas X.
[0020]
The structure formed in the configuration which filled up the tubed or box-like container with two or more ceramic pellets which are solid matter of configurations, such as a globular shape, cylindrical, cylindrical, and discoid, besides the single filter structure 7 of an arbitration configuration as an example of a configuration of the filter structure 7, and carried out packing of the opening with the network or the filter, the configuration filled up with fibrous material, the configuration formed in honeycomb-like structure, or monolith-like structure is possible.
[0021]
On the other hand, the power source 6 for discharge plasma generating carries out the load of the necessary output power to the discharge plasma reaction section 4 based on an input signal Y, and it can make the discharge plasma of necessary discharge power generate while making electric field form in the interior of the discharge plasma reaction section 4.
[0022]
And PM contained in exhaust gas X by the electrostatic precipitation-function and the particulate matter prehension function of the filter structure 7 by the electric field formed in the interior of the discharge plasma reaction section 4 can be made to catch in the filter structure 7.
[0023]
In addition, when specific inductive capacity consists of three or more dielectrics, the filter structure 7 can strengthen more the electric field formed in the discharge plasma reaction section 4, and can raise the prehension effectiveness of PM with an electrostatic precipitation-function.
[0024]
Furthermore, it is constituted so that PM which the oxidization radical of O, OH, and O_3 grade was generated by the discharge plasma inside the discharge plasma reaction section 4, and was caught by the oxidation of the generated oxidization radical in the filter structure 7 may be serially oxidized by CO_2 and the particulate matter prehension function of the filter structure 7 may be reproduced.
[0025]
At this time, inside the discharge plasma reaction section 4, NO oxidizes in an operation of the oxidization radical of O, OH, and O_3 grade among NOx contained in exhaust gas X, and NO_2 is generated. Generally, about 90vol% is NO among NOx contained in exhaust gas X in many cases.
[0026]
Furthermore, in the interior of the discharge plasma reaction section 4, the hydrocarbon contained in exhaust gas X oxidizes in an operation of an oxidization radical, and the chemical species of a partial oxidation object [CHO] etc. are generated. If a reduction decomposition catalyst exists, also in the low temperature of NOx contained in exhaust gas X, and not only the elevated temperature of hundreds of times or more but ordinary temperature extent, the reduction reaction of these chemical species can be carried out efficiently, and they can decompose NOx.
[0027]
So, the nitrogen-oxides (NOx) reduction catalyst 8 which understands NOx corresponding to the chemical species generated inside the discharge plasma reaction section 4 a returned part is formed in the NOx reduction catalyst section 5 prepared down-stream rather than the discharge plasma reaction section 4.
[0028]
Drawing 2 is drawing showing reduction decomposition of NOx in the discharge plasma reaction section 4

and the NOx reduction catalyst section 5 of the emission-gas-purification system 1 shown in drawing 1 .
[0029]
Generally as for NOx contained in exhaust gas X, NO occupies about 90vol%. Furthermore, if a hydrocarbon (CxHy) is contained in exhaust gas X, NO and CxHy will oxidize and the chemical species of NO2, a partial oxidation object [CHO], etc. will be generated by operation of the oxidization radical generated in connection with the discharge plasma in the discharge plasma reaction section 4.
[0030]
The chemical species generated in the discharge plasma reaction section 4 move to the NOx reduction catalyst section 5, and act as catalytic-reaction active species. In the NOx reduction catalyst section 5, organic nitro compound [CHON] etc is generated from NO2 and [CHO]. And NOx (NO/NO2) reacts as this [CHON] etc, N2, COx, and H2O are generated, and reduction decomposition of NOx is carried out.
[0031]
As a reduction decomposition catalyst of NOx, gamma-alumina without the byproduction of N2O is mentioned, for example. Although harmful N2O will occur in decomposition of NOx if the three way component catalyst which made noble metals, such as Pt conventionally used as a reduction decomposition catalyst of NOx, support is used, if gamma-alumina is used, the yield of this N2O can be reduced.
[0032]
Next, the detail configuration of the discharge plasma reaction section 4 of the emission-gas-purification system 1 and the power source 6 for discharge plasma generating is explained.
[0033]
Drawing 3 is drawing showing an example of the detail configuration of the discharge plasma reaction section 4 and the power source 6 for discharge plasma generating which are shown in drawing 1 .
[0034]
The discharge plasma reaction section 4 is formed on the tubing-like exhaust gas pipe 3 with which exhaust gas X flows. Furthermore, the connector 11 which consists of insulating materials is formed, and the discharge plasma reaction section 4 is constituted by the side face of the tubed electrode 10, while the filter structure 7 of a block configuration is formed in the tubed electrode 10 tubed interior. Furthermore, the column-like electrode 12 which turns to the longitudinal direction of the discharge plasma reaction section 4 is formed in the interior of the filter structure 7.
[0035]
And an one pole [of the power source 6 for discharge plasma generating], for example, high-voltage pole, side is connected to a connector 11 through an electrical cable 13. Furthermore, a connector 11 and the electrode 12 inside the filter structure 7 are connected through an electrical cable 13.
[0036]
Moreover, a pole [of another side of the power source 6 for discharge plasma generating], for example, grounding electrode, side is grounded while connecting with the tubed electrode 10 of the discharge plasma reaction section 4 through an electrical cable 13. That is, the tubed electrode 10 functions as an earth electrode.
[0037]
As a power source 6 for discharge plasma generating, for example as an input of the upstream of a power source, DC power supplies, such as a dc-battery of AC power supply (phi50Hz and 60Hz) or DC 12V and 24V, are used by AC 100V, 200V, and 400V, for example, the thing of the output voltage of the shape of a pulse (straight polarity, negative polarity, amphipathy of positive/negative) and the letter of an alternating current (a sine wave, intermittence sine wave) is used as secondary output voltage of a power source.
[0038]
Drawing 4 is drawing showing an example of the voltage waveform impressed to the discharge plasma reaction section 4 according to the power source 6 for discharge plasma generating shown in drawing 1 .
[0039]
The value of the electrical potential difference to which the power source 6 for discharge plasma generating outputs an axis of ordinate in drawing 4 , and an axis of abscissa show time amount. The curve 20 in drawing 4 shows the output voltage waveform 20 of the power source 6 for discharge plasma generating.
[0040]
As shown in the output voltage waveform 20 of drawing 4 , from the power source 6 for discharge plasma generating, the output voltage E of necessary magnitude is impressed to the electrode 12 by the side of the high-voltage pole of the discharge plasma reaction section 4 with the necessary output frequency lambda. The electrical potential difference impressed to the electrode 12 of the discharge plasma reaction section 4 is

set to several kV to about dozens of kV.

[0041]

The magnitude and the output frequency lambda of output voltage E which the power source 6 for discharge plasma generating impresses to an electrode 12 are set up possible [modification] based on an input signal Y. That is, the power source 6 for discharge plasma generating can control the output voltage E and the output frequency lambda which are outputted to the discharge plasma reaction section 4 based on an input signal Y.

[0042]

for this reason, the output voltage wave of the output frequency lambda outputted based on an input signal Y from the power source 6 for discharge plasma generating -- if the output voltage E of 20 is impressed between the electrodes 12 by the side of the tubed electrode 10 which is an earth electrode, and a high-voltage pole, the electric field which go to the side face of the discharge plasma reaction section 4 from an electrode 12, and the electric field which go to that hard flow will be formed by turns. The discharge plasma from which the sense changes by turns with the discharge power according to the output frequency lambda and output voltage E of the power source 6 for discharge plasma generating is generated by the filter structure of the tubed electrode 10 interior 7 interior with formation of this electric field.

[0043]

the output voltage wave outputted in the power source 6 for discharge plasma generating which shows drawing 5 to drawing 1 -- it is drawing showing an example of the relation between the output frequency lambda of 20, and the discharge power of the discharge plasma generated by the discharge plasma reaction section 4.

[0044]

The discharge power of the discharge plasma with which the axis of abscissa was generated by the value of the output frequency lambda of the power source 6 for discharge plasma generating, and the axis of ordinate was generated by the discharge plasma reaction section 4 in drawing 5 is shown. The continuous line 21 in drawing 5 is the frequency dependent straight line 21 which shows relation with the discharge power of the discharge plasma generated when seting output voltage E constant in the power source 6 for discharge plasma generating and changing an output frequency lambda.

[0045]

In addition, the unit of the discharge power of the discharge plasma is an arbitration unit.

[0046]

It turns out that the discharge power of the discharge plasma which will be generated if output voltage E is set constant in the power source 6 for discharge plasma generating from the frequency dependent straight line 21 shown in drawing 5 and an output frequency lambda is made to increase increases linearly.

[0047]

Drawing 6 is drawing showing an example of the relation between the output voltage E of the power source 6 for discharge plasma generating shown in drawing 1 , and the discharge power of the generated discharge plasma.

[0048]

The discharge power of the discharge plasma with which the axis of abscissa was generated by the value of the output voltage E of the power source 6 for discharge plasma generating, and the axis of ordinate was generated by the discharge plasma reaction section 4 in drawing 6 is shown. The continuous line 22 in drawing 6 is the electrical-potential-difference dependency curve 22 which shows relation with the discharge power of the discharge plasma generated when seting an output frequency lambda constant in the power source 6 for discharge plasma generating and changing output voltage E.

[0049]

In addition, the unit of the discharge power of the discharge plasma is an arbitration unit.

[0050]

It turns out that the discharge power of the discharge plasma which will be generated if an output frequency lambda is set constant in the power source 6 for discharge plasma generating from the electrical-potential-difference dependency curve 22 shown in drawing 6 and output voltage E is made to increase increases exponentially.

[0051]

That is, the discharge plasma reaction section 4 can be made to generate the discharge plasma of necessary discharge power by controlling one side or the both sides of output voltage E and an output frequency lambda from the relation shown in the example of drawing 5 thru/or drawing 6 based on the input signal Y

inputted into the power source 6 for discharge plasma generating.
[0052]
If the discharge plasma is furthermore generated in the discharge plasma reaction section 4, the oxidization radical of O of an amount according to the discharge power of the discharge plasma, OH, and O3 grade will be generated by the reaction with exhaust gas X.
[0053]
Drawing 7 is drawing showing an example of the relation between the discharge power which carried out close to the discharge plasma reaction section 4 from the power source 6 for discharge plasma generating shown in drawing 1 , and the amount of O3 generated in the discharge plasma reaction section 4.
[0054]
The discharge power which inputted the axis of abscissa into the discharge plasma reaction section 4 from the power source 6 for discharge plasma generating in drawing 7 , and an axis of ordinate show the amount of O3 generated in the discharge plasma reaction section 4. The - mark in drawing 7 shows the amount of O3 generated in the discharge plasma reaction section 4, when discharge power is changed to the discharge plasma reaction section 4 and is inputted into it from the power source 6 for discharge plasma generating, and a continuous line 23 is the discharge power dependency straight line 23 which shows the dependency over the discharge power of the amount of O3 generated in the discharge plasma reaction section 4.
[0055]
In addition, the data of drawing 7 are data at the time of making the amount of the oxygen O2 contained in exhaust gas X in the discharge plasma reaction section 4, and making temperature into 150 degrees C 15vol (s)%, and the unit of the amount of the gas of O3 grade is an arbitration unit.
[0056]
It turns out that the amount of O3 which will be generated in the discharge plasma reaction section 4 from - mark of drawing 7 and the discharge power dependency straight line 23 if the discharge power inputted into the discharge plasma reaction section 4 from the power source 6 for discharge plasma generating is made to increase increases linearly.
[0057]
Furthermore, if discharge power is fixed even if each values of the output voltage E of the power source 6 for discharge plasma generating and an output frequency lambda differ, it turns out that the amount of O3 generated in the discharge plasma reaction section 4 is almost fixed.
[0058]
If the oxidization radical of O3 grade is generated in the discharge plasma reaction section 4, since NO contained in exhaust gas X by the generated oxidization radical will oxidize and it will be set to NO2, the amount of NO contained in exhaust gas X is reduced. For this reason, it depends for the amount of reduction of NO in exhaust gas X in the discharge plasma reaction section 4 on the amount of generation of an oxidization radical. Further, the amount of generation of the oxidization radical in the discharge plasma reaction section 4 depends also for the amount of reduction of NO on the discharge power of the power source 6 for discharge plasma generating, in order to be dependent on the discharge power of the power source 6 for discharge plasma generating.
[0059]
Drawing 8 is drawing showing an example of the relation between the discharge power which carried out close to the discharge plasma reaction section 4 from the power source 6 for discharge plasma generating shown in drawing 1 , and the amount of reduction of NO in the discharge plasma reaction section 4.
[0060]
In drawing 8 , the discharge power which inputted the axis of abscissa into the discharge plasma reaction section 4 from the power source 6 for discharge plasma generating, and an axis of ordinate show the amount of reduction of NO in the discharge plasma reaction section 4. - mark in drawing 8 is data in which the amount of reduction of NO when changing the discharge power of the power source 6 for discharge plasma generating when the concentration of NO in exhaust gas X in the inlet port of the discharge plasma reaction section 4 is 200 ppm is shown. O The mark is data in which the amount of reduction of NO when changing the discharge power of the power source 6 for discharge plasma generating is shown, when the concentration of NO in exhaust gas X in the inlet port of the discharge plasma reaction section 4 is 100 ppm.

[0061]
Moreover, the continuous line 24 in drawing 8 shows the amount data 24 of NO reduction which tied each data (- mark) in case the concentration of NO in exhaust gas X in the inlet port of the discharge plasma

reaction section 4 is 200 ppm, and were obtained. A dotted line 25 shows the amount data 25 of NO reduction which tied each data (O mark) in case the concentration of NO in exhaust gas X in the inlet port of the discharge plasma reaction section 4 is 100 ppm, and were obtained.

[0062]
According to - mark and the continuous line 24 in drawing 8 , when the discharge power of the power source 6 for discharge plasma generating is made to increase from 0 (Wh/Nm3), the amount of NO reduction also increases linearly with the increment in discharge power, but when the amount of NO reduction approaches 200 ppm, even if it makes discharge power increase, it turns out that the augend of the amount of NO reduction decreases.

[0063]
Similarly, according to O mark and the dotted line 25, when the discharge power of the power source 6 for discharge plasma generating is made to increase from 0 (Wh/Nm3), the amount of NO reduction increases linearly with the increment in discharge power, but When set to 100 ppm, even if the augend of the amount of NO reduction will decrease if the amount of NO reduction approaches 100 ppm, the amount of NO reduction increases further, and it makes discharge power increase, it already turns out that the amount of NO reduction does not increase.

[0064]
That is, although the amount of NO reduction also increases linearly since the amount of generation of the oxidization radical of O3 grade will increase linearly if the discharge power of the power source 6 for discharge plasma generating is made to increase as shown in drawing 7 , drawing 8 shows that the amount of NO reduction does not increase more than the concentration of NO in exhaust gas X in the inlet port of the discharge plasma reaction section 4.

[0065]
Furthermore, when the amount of NO reduction of the discharge plasma reaction section 4 becomes concentration extent of NO in exhaust-gas X in the inlet port of the discharge plasma reaction section 4 from drawing 8 , even if it makes the discharge power of the power source 6 for discharge plasma generating increase, since the discharge power to which it was made to increase is lost without contributing to reduction of NO, it understands that it is desirable to make discharge power small.

[0066]
On the other hand, when the amount of NO reduction is set to 100 ppm or less according to drawing 8 , even if the concentration of NO in exhaust gas X in the inlet port of the discharge plasma reaction section 4 is 100 ppm and it is 200 ppm, it turns out that the comparable amount of NO reduction is obtained with the same discharge power.

[0067]
for this reason, when the amount of NO reduction of the discharge plasma reaction section 4 is smaller enough than the concentration of NO in exhaust gas X in the inlet port of the discharge plasma reaction section 4 By inputting larger discharge power into the discharge plasma reaction section 4 from the power source 6 for discharge plasma generating regardless of the concentration of NO in exhaust gas X in the inlet port of the discharge plasma reaction section 4 shows that the amount of NO reduction can be made to increase.

[0068]
NO contained in exhaust gas X by the oxidization radical in the discharge plasma reaction section 4 oxidizes, it is set to NO2, and, finally NOx is purified by being led to the NOx reduction catalyst section 5, and carrying out reduction decomposition with NO which remained without oxidizing.

[0069]
Drawing 9 is drawing showing an example of the relation between the discharge power of the power source 6 for discharge plasma generating shown in drawing 1 , and the amount of reduction of NO in the discharge plasma reaction section 4, and drawing 10 is drawing showing an example of relation with the amount of reduction of NOx in the discharge power and the emission-gas-purification system 1 of the power source 6 for discharge plasma generating shown in drawing 1 .

[0070]
In drawing 9 , the amount [in / an axis of abscissa, and / in an axis of ordinate / the discharge plasma reaction section 4] of reduction of NO is shown. [the discharge power of the power source 6 for discharge plasma generating] O mark in drawing 9 is data in which the amount of reduction of NO in the discharge plasma reaction section 4 when changing the discharge power of the power source 6 for discharge plasma generating is shown, and a continuous line 26 is the amount data straight line 26 of NO reduction obtained

from the data (O mark) of the amount of reduction of NO.
[0071]
Moreover, in drawing 10 , the amount of reduction of NOx [in / an axis of abscissa and / in an axis of ordinate / the emission-gas-purification system 1] is shown. [the discharge power of the power source 6 for discharge plasma generating] - mark in drawing 10 is data in which the amount of reduction of NOx after reduction decomposition of NOx was carried out in the NOx reduction catalyst section 5 when changing the discharge power of the power source 6 for discharge plasma generating is shown, and O mark is data in which the amount of reduction of NOx in the discharge plasma reaction section 4 before reduction decomposition of NOx is carried out in the NOx reduction catalyst section 5 is shown.
[0072]
Moreover, a continuous line 27 is the amount data straight line 27 of NO reduction obtained from each data (- mark) in which the amount of reduction of NOx after reduction decomposition of NOx was carried out in the NOx reduction catalyst section 5 is shown, and a dotted line 28 is the amount data straight line 28 of NO reduction obtained from each data (O mark) in which the amount of reduction of NOx before reduction decomposition of NOx is carried out in the NOx reduction catalyst section 5 is shown in drawing 10 .
[0073]
In addition, the data (- mark, O mark) of ** of drawing 9 and drawing 10 and the amount data straight lines 27 and 28 of NO reduction are data in case exhaust gas temperature is 300 degrees C, and the discharge power of the power source 6 for discharge plasma generating is the discharge power of the range which the amount of NO reduction thru/or the amount of NOx reduction increase linearly, when discharge power is made to increase.
[0074]
For this reason, as shown in drawing 9 , the amount of NO reduction increases linearly with the increment in the discharge power of the power source 6 for discharge plasma generating.
[0075]
On the other hand, according to the amount data straight line 28 of NO reduction shown by O mark and the dotted line of drawing 10 , the amount of reduction of NOx before reduction decomposition of NOx is carried out in the NOx reduction catalyst section 5 is zero mostly. That is, although the amount of NO is reduced according to an operation of an oxidization radical in the discharge plasma reaction section 4, NO2 of the amount equivalent to the amount of NO reduction is generated, it accumulates, and it turns out that the amount of whole NOx is about comparable.
[0076]
Furthermore, according to the amount data straight line 27 of NO reduction shown as - mark and the continuous line of drawing 10 , the amount of reduction of NOx after reduction decomposition of NOx was carried out in the NOx reduction catalyst section 5 is increasing linearly with the increment in the discharge power of the power source 6 for discharge plasma generating.
[0077]
That is, when the ratio of NO2 which is made to increase the amount of generation of NO2, and is contained in NOx by making the amount of NO reduction in the discharge plasma reaction section 4 increase is made to increase, it understands that the amount of NOx by which reduction decomposition is carried out in the NOx reduction catalyst section 5 can increase, and the amount of reduction of whole NOx can be made to increase linearly.
[0078]
therefore, when there are more amounts of NO contained in exhaust gas X than the amount of NO reduction and the amount of NO reduction increases linearly with the increment in the discharge power of the power source 6 for discharge plasma generating While discharge power makes it increase and the amount of NOx reduction is made to increase, the amount of NO contained in exhaust gas X is amount extent of NO reduction. Even if it makes the discharge power of the power source 6 for discharge plasma generating increase, when the amount of NO reduction and the amount of NOx reduction do not increase notably, by decreasing discharge power, decomposition processing of NOx of efficient more many in the discharge power of low-power output can be carried out, and exhaust gas X can be purified.
[0079]
Furthermore, in addition to the amount of NOx contained in exhaust gas X, or NO, it depends for the discharge electric energy of the optimal power source 6 for discharge plasma generating also according to the conditions of other exhaust gas X.
[0080]

Then, the input signal Y for controlling discharge electric energy according to the conditions of exhaust gas X is inputted into the power source 6 for discharge plasma generating, and based on the inputted input signal Y, it is constituted so that one side or the both sides of output voltage E and an output frequency lambda may be controlled and the more nearly optimal discharge power may be supplied to the discharge plasma reaction section 4.

[0081]
Next, the decision approach of the input signal Y inputted into the power source 6 for discharge plasma generating is explained.

[0082]
The amount of the oxidization radical generated in the discharge plasma reaction section 4 is proportional to the discharge power per unit flow rate of exhaust gas X. For this reason, if the discharge power per unit flow rate of exhaust gas X is made to increase, the amount of reduction of NO will increase with the amount of generation of an oxidization radical. Since the discharge power per unit flow rate of exhaust gas X is decided from the flow rate and discharge power of exhaust gas X, it will depend for the optimal discharge power on the flow rate of exhaust gas X.

[0083]
That is, the discharge power per unit flow rate of exhaust gas X also becomes large, and the amount of reduction of NO increases with the amount of generation of an oxidization radical, so that discharge power is large, when the amount of reduction of NO is smaller enough than the concentration of NO in the inlet port of the discharge plasma reaction section 4.

[0084]
However, while discharge power required since the amount of reduction of NO serves as near [in the inlet port of the discharge plasma reaction section 4] the concentration of NO becomes so large that there are many flow rates of exhaust gas X, it becomes so small that there are few flow rates of exhaust gas X.

[0085]
For this reason, by making the amount of emission into an input signal Y, it can depend according to the amount of emission, and the power source 6 for discharge plasma generating can be controlled to make suitable discharge power output.

[0086]
In addition, the amount of emission can be calculated from the rotational frequency of an engine 2.

[0087]
Drawing 11 is drawing showing an example of the engine speed of an engine 2, and the relation of the amount of emission discharged from an engine 2.

[0088]
In drawing 11 , an axis of abscissa shows the engine speed of an engine 2, and the amount of emission by which an axis of ordinate is discharged from an engine 2. In drawing 11 , - mark shows the amount value of emission discharged from the engine 2 in each engine speed of an engine 2, and a continuous line 29 is the amount data straight line 29 of emission obtained from each data (- mark).

[0089]
As shown in the amount data straight line 29 of emission of drawing 11 , the engine speed of an engine 2 and the amount of emission discharged from an engine 2 have a linear relation, and can obtain the amount of emission from the engine speed of an engine 2 based on the amount data straight line of emission.

[0090]
For this reason, when measurement makes the rotational frequency of the easy engine 2 an input signal Y instead of the amount of emission, it can depend according to the amount of emission, and the power source 6 for discharge plasma generating can be controlled to make suitable discharge power output.

[0091]
Moreover, it depends for the rate of reduction of NOx in the emission-gas-purification system 1 on the temperature of exhaust gas X discharged from an engine 2.

[0092]
Drawing 12 is drawing showing an example of the relation between the rate of reduction of NOx when decomposing NOx contained in exhaust gas X in the emission-gas-purification system 1, and the temperature of exhaust gas X.

[0093]
In drawing 12 , an axis of ordinate shows the rate of reduction of NOx, and an axis of abscissa shows the temperature (degree C) of exhaust gas X.

[0094]
Moreover, dotted-line 30a in drawing 12 It is NOx reduction curvilinear 30a which shows the relation between the rate of reduction of NOx when discharge power of the power source 6 for discharge plasma generating is made into zero in the emission-gas-purification system 1, namely, when an operation of only the NOx reduction catalyst section 5 decomposes NOx, and the temperature of exhaust gas X. When each continuous lines 30b, 30c, and 30d set discharge power as each value in the emission-gas-purification system 1 They are the NOx reduction curves 30b, 30c, and 30d which show the relation between the rate of reduction of NOx when using together the reduction in the oxidation of NO and the NOx reduction catalyst section 5 by the discharge in ** 4, i.e., the discharge plasma reaction section, and the temperature of exhaust gas X.
[0095]
In addition, the NOx reduction curves 30d and 30c which show the value with the larger rate of NOx reduction among each NOx reduction curves 30b, 30c, and 30d shown as a continuous line are data at the time of setting up greatly the discharge power of the power source 6 for discharge plasma generating rather than the NOx reduction curves 30c and 30b which show a value with the smaller rate of NOx reduction.
[0096]
As shown in drawing 12 , the rate of NOx reduction increases depending on exhaust gas temperature regardless of each discharge power of the power source 6 for discharge plasma generating, but it turns out that the inclination increases with exhaust gas temperature, so that discharge power is small. on the other hand, the discharge power of the power source 6 for discharge plasma generating is greatly alike, takes, and it turns out that the rate of NOx reduction increases about linearly depending on exhaust gas temperature.
[0097]
That is, it turns out that the difference of the rate of NOx reduction in each discharge power of the power source 6 for discharge plasma generating becomes small, so that exhaust gas temperature is high, and the difference of the rate of NOx reduction in each discharge power becomes large, so that exhaust gas temperature is low.
[0098]
For example, although exhaust gas temperature increases notably with the increment in discharge power in near 200 degree C in drawing 12 , even if the rate of NOx reduction makes discharge power increase in near 450 degree C, as for the rate of NOx reduction, it serves as same value.
[0099]
or [therefore, / it being effective for NOx reduction to make the discharge power of the power source 6 for discharge plasma generating increase, when exhaust gas temperature is low, but controlling the increment in discharge power, since there is little effectiveness to the rate of NOx reduction even if it makes discharge power increase when exhaust gas temperature is high] -- or it turns out that it becomes more efficient to make it decrease.
[0100]
For this reason, by making exhaust gas temperature into the input signal Y of the power source 6 for discharge plasma generating, it can depend according to exhaust gas temperature, and the power source 6 for discharge plasma generating can be controlled to make suitable discharge power output.
[0101]
In addition, exhaust gas temperature can be searched for from an engine speed or an engine torque.
[0102]
Drawing 13 is drawing showing an example of the relation between the rate conditions of an engine 2, and the exhaust gas temperature discharged from an engine 2.
[0103]
In drawing 13 , an axis of abscissa shows the rate of an automobile, and an axis of ordinate shows the temperature of exhaust gas X discharged from an engine 2. - mark in drawing 13 is data of the exhaust gas temperature in each rate of an automobile, and continuous-line 31a is exhaust gas temperature straight-line 31a obtained from the data (- mark) of each exhaust gas temperature.
[0104]
It turns out that it has a relation with linear rate and exhaust gas temperature of an automobile as shown in exhaust gas temperature straight-line 31a of drawing 13 . Since the rate of an automobile is proportional to the engine speed of an engine 2, it will have a relation with almost linear engine speed and exhaust gas temperature of an engine 2.
[0105]

On the other hand, if an engine torque is changed, and an engine torque is enlarged, for example, it will be known that exhaust gas temperature straight-line 31b shown by the dotted line will be obtained. That is, it turns out that exhaust gas temperature also has an about linear relation in an engine torque.
[0106]
Therefore, exhaust gas temperature can be searched for from an engine speed or an engine torque.
[0107]
For this reason, when it replaces with exhaust gas temperature and measurement makes an easy engine speed or an easy engine torque the input signal Y of the power source 6 for discharge plasma generating, it can depend according to exhaust gas temperature, and the power source 6 for discharge plasma generating can be controlled to make suitable discharge power output.
[0108]
Moreover, when the amount of reduction of NO in the emission-gas-purification system 1 becomes equivalent to NO concentration in the inlet port of the discharge plasma reaction section 4, it is required to make the increment in the discharge power of the power source 6 for discharge plasma generating control.
[0109]
For this reason, by making into the input signal Y of the power source 6 for discharge plasma generating NO concentration contained in exhaust gas X, it can depend according to NO concentration and the power source 6 for discharge plasma generating can be controlled to make suitable discharge power output.
[0110]
Moreover, it depends for the amount of reduction of NO in the discharge plasma reaction section 4 of the emission-gas-purification system 1 on the concentration of hydrocarbons, such as a propylene (C3H6) which is the NOx reducing agent contained in exhaust gas X.
[0111]
Drawing 14 is drawing showing an example of the relation between C3H6 concentration contained in exhaust gas X, and the amount of reduction of NO in the discharge plasma reaction section 4.
[0112]
In drawing 14 , C3H6 concentration and the axis of ordinate by which an axis of abscissa is included in exhaust gas X show the amount of reduction of NO in the discharge plasma reaction section 4. - mark in drawing 14 -- every -- the data of the amount of NO reduction in C3H6 concentration -- it is -- a continuous line 32 -- every -- it is the amount curve 32 of NO reduction obtained from the data (- mark) of the amount of NO reduction.
[0113]
in addition, every -- the data (- mark) of the amount of NO reduction are data when seting discharge power constant and setting initial concentration before reduction of 150 degrees C and NO concentration to 200 ppm for exhaust gas temperature.
[0114]
If C3H6 concentration contained in exhaust gas X and the amount of reduction of NO in the discharge plasma reaction section 4 have fixed conditions, such as discharge power and exhaust gas temperature, as shown in the amount curve 32 of NO reduction of drawing 14 , it turns out that it is proportional.
[0115]
Therefore, according to C3H6 concentration contained in exhaust gas X, the discharge power of the power source 6 for discharge plasma generating in case the amount of reduction of NO becomes equivalent to NO concentration in the inlet port of the discharge plasma reaction section 4 will be decided.
[0116]
That is, with the discharge power of the smaller power source 6 for discharge plasma generating, the amount of reduction of NO will need to become equivalent to NO concentration in the inlet port of the discharge plasma reaction section 4, and will need to control an increment in smaller discharge electric energy, so that C3H6 concentration contained in exhaust gas X is large.
[0117]
For this reason, by making into the input signal Y of the power source 6 for discharge plasma generating the amounts of hydrocarbons, such as C3H6 amount contained in exhaust gas X, the amount of reduction of NO is made to increase efficiently, and the power source 6 for discharge plasma generating can be controlled to make more suitable discharge power output.
[0118]
In addition, it depends for the amount of the hydrocarbon of the C3H6 grade contained in exhaust gas X discharged from an engine 2 on the air supplied to an engine 2, and the air-fuel ratio which is the ratio of a

fuel.
[0119]
Drawing 15 is drawing showing the air-fuel ratio of the common engine 2, and the relation of the amount of hydrocarbons contained in exhaust gas X.
[0120]
In drawing 15 , an axis of abscissa shows the air-fuel ratio of an engine 2, and an axis of ordinate shows the amount of hydrocarbons contained in exhaust gas X. The continuous line 33 in drawing 15 is the amount curve 33 of hydrocarbons which shows the air-fuel ratio of an engine 2, and the relation of the amount of hydrocarbons contained in exhaust gas X.
[0121]
The amount of hydrocarbons by which the fuel contained in air is contained in exhaust gas X in few Lean fields from the amount curve 33 of hydrocarbons shown in drawing 15 , so that the air-fuel ratio of an engine 2 is large decreases. On the contrary, in a rich field with many amounts of the fuel contained in air, the amount of hydrocarbons contained in exhaust gas X increases, so that the air-fuel ratio of an engine 2 is small.
[0122]
If the amount curve 33 of hydrocarbons of drawing 15 shows the air-fuel ratio of an engine 2, the amount of hydrocarbons contained in exhaust gas X can be obtained.
[0123]
Therefore, by replacing with the amount of hydrocarbons contained in exhaust gas X, and making the air-fuel ratio of an engine 2 into the input signal Y of the power source 6 for discharge plasma generating, when the amount of NO reduction according to the amount of hydrocarbons is obtained, the power source 6 for discharge plasma generating can be controlled to make suitable discharge power output.
[0124]
Moreover, according to the concentration of NOx by which the rate of reduction of NOx in the emission-gas-purification system 1 of reduction, i.e., the amount of NO, is contained in exhaust gas X, the discharge electric energy of the suitable power source 6 for discharge plasma generating is determined. It depends on the concentration of NOx for the concentration of NO contained in exhaust gas X. And when the amount of NO reduction becomes equivalent to NO concentration in the inlet port of the discharge plasma reaction section 4, it is necessary to make the increment in the discharge power of the power source 6 for discharge plasma generating control in the discharge plasma reaction section 4.
[0125]
Therefore, by making into the input signal Y of the power source 6 for discharge plasma generating concentration of NOx contained in exhaust gas X, it can depend according to NOx concentration and the power source 6 for discharge plasma generating can be controlled to make suitable discharge power output.
[0126]
In addition, it can ask for the concentration of NOx contained in exhaust gas X from an engine speed or an engine torque.
[0127]
Drawing 16 is drawing showing an example of the rate conditions of an engine 2, and the relation of the NOx concentration contained in exhaust gas X discharged from an engine 2.
[0128]
In drawing 16 , an axis of abscissa shows the rate of an automobile, and an axis of ordinate shows the NOx concentration contained in exhaust gas X discharged from an engine 2. - mark in drawing 16 is data of the NOx concentration in each rate of an automobile, and continuous-line 34a is NOx density curve 34a obtained from the data (- mark) of each NOx concentration.
[0129]
It turns out that the NOx concentration contained in exhaust gas X increases as are shown in NOx density curve 34a of drawing 16 and the rate of an automobile increases. Since the rate of an automobile is proportional to the engine speed of an engine 2, if the engine speed of an engine 2 is known, it can ask for the NOx concentration contained in exhaust gas X from NOx density curve 34a.
[0130]
On the other hand, if an engine torque is changed, and an engine torque is enlarged, for example, it will be known that NOx density curve 34b shown by the dotted line will be obtained. That is, if an engine torque is known, it can ask for the NOx concentration contained in exhaust gas X from NOx density curve 34b.
[0131]

Therefore, it can ask for the NOx concentration contained in exhaust gas X from an engine speed or an engine torque.
[0132]
For this reason, when it replaces with the NOx concentration contained in exhaust gas X and measurement makes an easy engine speed or an easy engine torque the input signal Y of the power source 6 for discharge plasma generating, it can depend according to NOx concentration and the power source 6 for discharge plasma generating can be controlled to make suitable discharge power output.
[0133]
In addition, a signal input means may establish separately and the input signal Y which inputs into the power source 6 for discharge plasma generating may be any of the configuration which carries out a direct input to the power source 6 for discharge plasma generating from an engine 2, the configuration which inputs an input signal Y into the power source 6 for discharge plasma generating from this signal input means, or a configuration of inputting an input signal Y into the power source 6 for discharge plasma generating from an engine 2 and the both sides of a signal input means.
[0134]
When inputting an input signal Y into the power source 6 for discharge plasma generating from a signal input means, an input signal Y can be set up by forming various metering devices, such as a concentration meter which measures the necessary concentration or the necessary amount of a component contained in the thermometer which measures the temperature of exhaust gas X, the flowmeter which measures the amount of emission, and exhaust gas X, in an exhaust gas pipe 3.
[0135]
Next, an operation of the emission-gas-purification system 1 is explained.
[0136]
Exhaust gas X which contains PM thru/or NOx in an engine 2 is generated, and this exhaust gas X is led to the interior of the filter structure 7 of the discharge plasma reaction section 4 through an exhaust gas pipe 3.
[0137]
At this time, the service condition of the engines 2, such as an engine speed of an engine 2 or an engine torque, and an air-fuel ratio, is regularly inputted into the power source 6 for discharge plasma generating as an input signal Y.
[0138]
And the power source 6 for discharge plasma generating impresses the output voltage E of straight polarity, and the output voltage E of negative polarity to the electrode 12 by the side of the high-voltage pole which set up regularly the output voltage E which serves as the optimal discharge power for purification of exhaust gas X, and an output frequency lambda based on the input signal Y inputted from the engine 2, and was prepared in the filter structure 7 by turns.
[0139]
For this reason, while electric field are formed between the tubed electrode 10 by the side of a wrap earth electrode, and the electrode 12 by the side of a high-voltage pole, the discharge plasma generates the filter structure 7. And in addition to PM prehension function of the filter structure 7, PM contained in exhaust gas X by the electrostatic precipitation-function by the electric field formed in the interior of the filter structure 7 is caught inside the filter structure 7.
[0140]
Moreover, the oxidization radical of O, OH, and O3 grade is generated by the discharge plasma reaction section 4 according to an operation of the discharge plasma. And combustion processing of the matter, such as carbon contained in PM caught by the filter structure 7 according to an operation of this oxidization radical, is carried out serially to a carbon dioxide CO 2, while PM prehension function of the filter structure 7 is reproduced, NO oxidizes among NOx contained in exhaust gas X, it is set to NO2, and NO concentration is reduced.
[0141]
Furthermore , it be regularly control to become the minimum discharge power required since the discharge power of the power source 6 for discharge plasma generating be base on the input signal Y inputted from the engine 2 and serve as NO concentration and equivalent extent in the discharge plasma reaction section 4 at this time . [in / in the amount of NO reduction / discharge plasma reaction section 4 inlet port]
[0142]
Moreover, in the interior of the discharge plasma reaction section 4, the hydrocarbon contained in exhaust gas X oxidizes in an operation of an oxidization radical, and the chemical species of a partial oxidation

object [CHO] etc. are generated.
[0143]
And exhaust gas X is led to the NOx reduction catalyst section 5 through an exhaust gas pipe 3, where components, such as NO2 removed and generated in PM, NO which remained without oxidizing, and chemical species, are included.
[0144]
Since the reduction decomposition catalyst which understands NOx corresponding to the chemical species generated by the discharge plasma reaction section 4 a returned part is prepared in the NOx reduction catalyst section 5, reduction decomposition is carried out and NOx contained in exhaust gas X in the NOx reduction catalyst section 5 is processed.
[0145]
And exhaust gas X by which NOx was processed and purified in the NOx reduction catalyst section 5 is discharged by the exterior of the emission-gas-purification system 1.
[0146]
That is, the emission-gas-purification system 1 forms electric field in the filter structure 7 interior, in order to catch PM contained in exhaust gas X, in addition to PM prehension function of the filter structure 7, it catches PM by the electrostatic precipitation-function, and is the configuration of carrying out combustion processing and reproducing PM prehension function of the filter structure 7, without heating by the discharge plasma which does not depend on temperature for caught PM.
[0147]
Moreover, while the emission-gas-purification system 1 forms the NOx reduction catalyst section 5 possessing the reduction decomposition catalyst of NOx down-stream rather than the discharge plasma reaction section 4, it is a removed configuration which carries out reduction decomposition, without generating chemical species, such as [CHO], and heating NOx from exhaust-gas X in the NOx reduction catalyst section 5, while changing into NO2 with a reduction decomposition catalyst and reactivity higher than NO in the discharge plasma reaction section 4.
[0148]
Furthermore, it is the configuration of making suitable discharge power purifying exhaust gas X by controlling by the input signal Y set as the operational status of an engine 2 according to conditions, such as an amount of exhaust gas X changed with the discharge power of the power source 6 for discharge plasma generating impressed to the discharge plasma reaction section 4, temperature, and a component, at this time.
[0149]
In the emission-gas-purification system 1, combustion processing can be carried out continuously and efficient also not only in an elevated temperature but in low temperature according to an operation of the discharge plasma which catches PM contained in exhaust gas X by the filter structure 7, and cannot receive effect of a temperature change easily.
[0150]
Moreover, in the emission-gas-purification system 1, instead of measuring temperature or a component of exhaust gas X etc., when measurement measures the engine speed and engine torque of an easy engine, an input signal can be set up more easily.
[0151]
Moreover, since the chemical species which carry out a reduction reaction also in NOx and low temperature in an operation of the discharge plasma are generated, even if it is low temperature, without heating NOx by forming the NOx reduction catalyst section 5 in addition to PM, it can understand a returned part.
[0152]
Furthermore, since the discharge power of the power source 6 for discharge plasma generating is controlled optimally by the emission-gas-purification system 1 with the input signal Y set up according to conditions, such as an amount of exhaust gas X, temperature, and a component, superfluous discharge power can be reduced and more suitable and cheap discharge power can be made to purify exhaust gas X efficiently.
[0153]
In addition, the setting approach of the input signal of the power source 6 for discharge plasma generating of the emission-gas-purification system 1 is good also as an approach of taking into consideration only about the conditions of arbitration and setting up an input signal, without considering that the conditions of arbitration are fixed and taking them into consideration among conditions, such as an amount of exhaust gas X, temperature, and a component, or conditions, such as an engine service condition.
[0154]

Moreover, in the discharge plasma reaction section 4 of the emission-gas-purification system 1, the electrode of a high-voltage pole lateral electrode may be replaced an earth electrode side, and the configuration and number of the filter structure 7 and electrodes are arbitrary.

[0155]

moreover, generating the discharge plasma cuts by making into the low-temperature plasma only with a high electron temperature the discharge plasma which the discharge plasma reaction section 4 is made to generate, without heating exhaust gas X. If the low-temperature plasma is used, the power supplied to the discharge plasma reaction section 4 will be used for the energy of the electron inside the discharge plasma reaction section 4, and will not be used as heat energy of a neutral molecule or ion. For this reason, energy loss can be reduced, an electron can be activated more with the power of low-power output, and more oxidization radicals can be generated.

[0156]

Moreover, it is good also as a configuration which makes the configuration or the filter structure 7 which makes the ingredient of the filter structure 7 the reduction decomposition catalyst of NOx in the emission-gas-purification system 1 support the reduction decomposition catalyst of NOx.

[0157]

[Effect of the Invention]

In the emission-gas-purification system and the emission-gas-purification approach concerning this invention, according to a service condition, it can be changed and discharged from the engine used as sources of power, such as an automobile, and it can remove more efficiently cheaply with the power of low-power output at low temperature, without heating harmful matter from the exhaust gas containing harmful matter, such as particulate matter and nitrogen oxides, and exhaust gas can be purified.

[Brief Description of the Drawings]

[Drawing 1] The block diagram showing the gestalt of operation of the emission-gas-purification system concerning this invention.

[Drawing 2] Drawing showing reduction decomposition of NOx in the discharge plasma reaction section and the NOx reduction catalyst section of the emission-gas-purification system shown in drawing 1 .

[Drawing 3] Drawing showing an example of the detail configuration of the discharge plasma reaction section and the power source for discharge plasma generating which are shown in drawing 1 .

[Drawing 4] Drawing showing an example of the voltage waveform impressed to the discharge plasma reaction section according to the power source for discharge plasma generating shown in drawing 1 .

[Drawing 5] Drawing showing an example of the relation between the frequency of the voltage waveform outputted in the power source for discharge plasma generating shown in drawing 1 , and the discharge power of the discharge plasma generated by the discharge plasma reaction section.

[Drawing 6] Drawing showing an example of the relation between the output voltage of the power source for discharge plasma generating shown in drawing 1 , and the discharge power of the generated discharge plasma.

[Drawing 7] Drawing showing an example of the relation between the discharge power which carried out close to the discharge plasma reaction section from the power source for discharge plasma generating shown in drawing 1 , and the amount of O3 generated in the discharge plasma reaction section.

[Drawing 8] Drawing showing an example of the relation between the discharge power which carried out close to the discharge plasma reaction section from the power source for discharge plasma generating shown in drawing 1 , and the amount of reduction of NO in the discharge plasma reaction section.

[Drawing 9] Drawing showing an example of the relation between the discharge power of the power source for discharge plasma generating shown in drawing 1 , and the amount of reduction of NO in the discharge plasma reaction section.

[Drawing 10] Drawing showing an example of relation with the amount of reduction of NOx in the discharge power and the emission-gas-purification system of the power source for discharge plasma generating shown in drawing 1 .

[Drawing 11] Drawing showing an example of an engine engine speed and the relation of the amount of emission discharged from an engine.

[Drawing 12] Drawing showing an example of the relation between the rate of reduction of NOx when decomposing NOx contained in exhaust gas in an emission-gas-purification system, and the temperature of exhaust gas.

[Drawing 13] Drawing showing an example of the relation between engine rate conditions and the exhaust gas temperature discharged from an engine.

[Drawing 14] Drawing showing an example of the relation between C3H6 concentration contained in exhaust gas, and the amount of reduction of NO in the discharge plasma reaction section.
[Drawing 15] Drawing showing the air-fuel ratio of a common engine, and the relation of the amount of hydrocarbons contained in exhaust gas.
[Drawing 16] Drawing showing an example of engine rate conditions and the relation of the NOx concentration contained in the exhaust gas discharged from an engine.
[Description of Notations]
1 Emission-Gas-Purification System
2 Engine
3 Exhaust Gas Pipe
4 Discharge Plasma Reaction Section
5 NOx Reduction Catalyst Section
6 Power Source for Discharge Plasma Generating
7 Filter Structure
8 Nitrogen-Oxides (NOx) Reduction Catalyst
10 Tubed Electrode
11 Connector
12 Electrode
13 Electrical Cable
20 Output Voltage Wave
21 Frequency Dependent Straight Line
22 Electrical-Potential-Difference Dependency Curve
23 Discharge Power Dependency Straight Line
24 The Amount Data of NO Reduction
25 The Amount Data of NO Reduction
26 The Amount Data Straight Line of NO Reduction
27 The Amount Data Straight Line of NO Reduction
28 The Amount Data Straight Line of NO Reduction
29 The Amount Data Straight Line of Emission
30a, 30b, 30c, 30d NOx reduction curve
31a, 31b Exhaust gas temperature straight line
32 The Amount Curve of NO Reduction
33 The Amount Curve of Hydrocarbons
34a, 34b NOx density curve
X Exhaust gas
Y Input signal

[Translation done.]

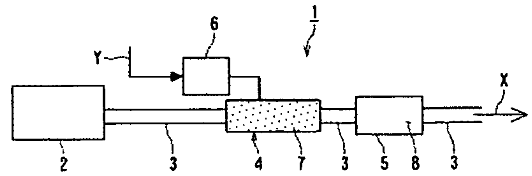
* NOTICES *

JPO and NCIPI are not responsible for any damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

[Drawing 1]



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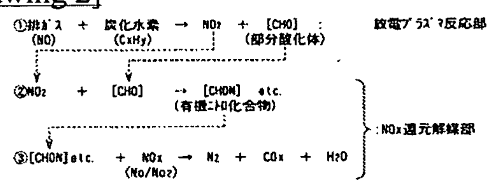

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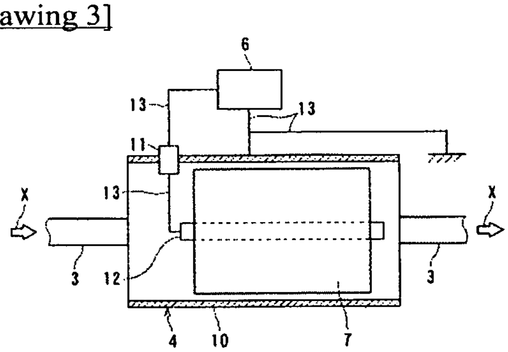

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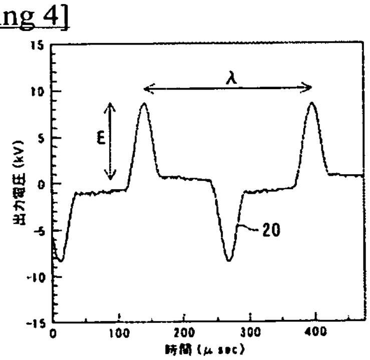

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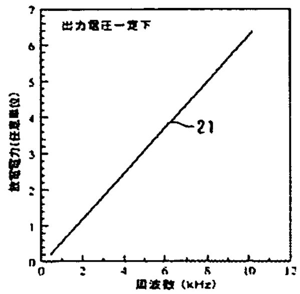

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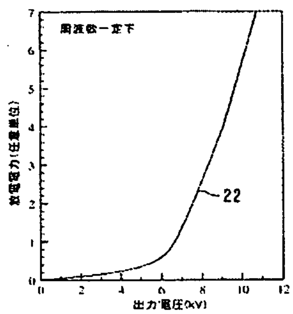

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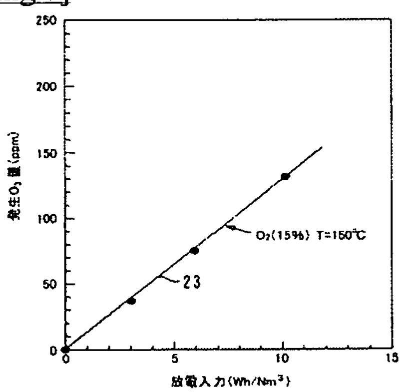

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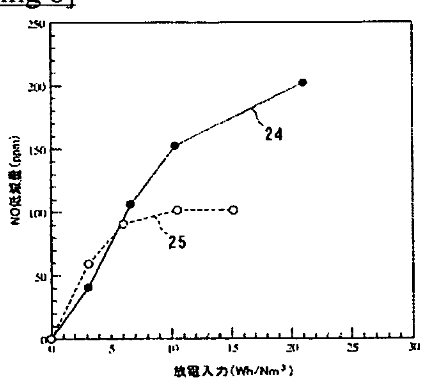

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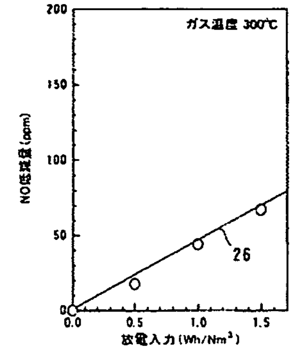

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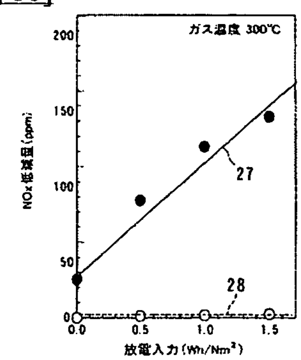

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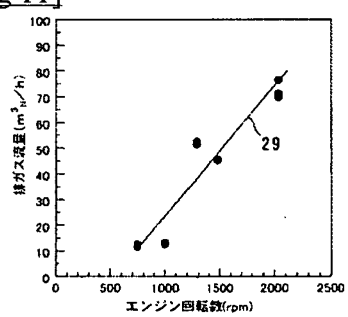

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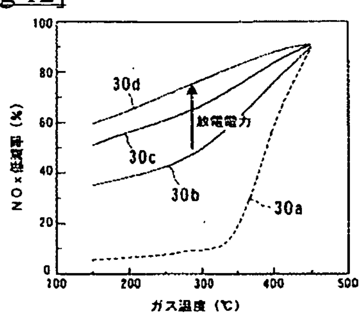

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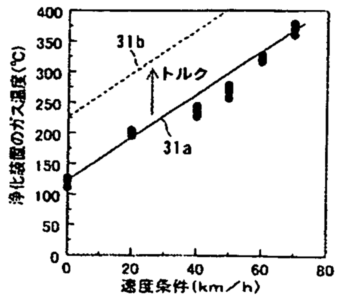

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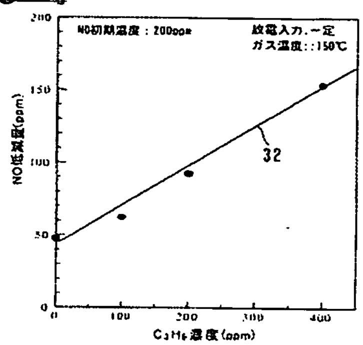

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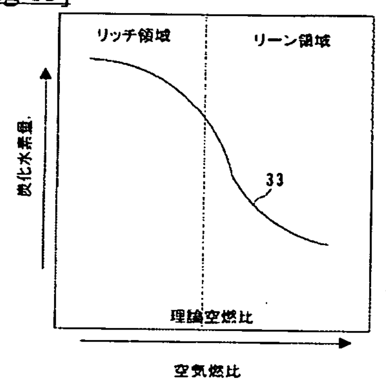

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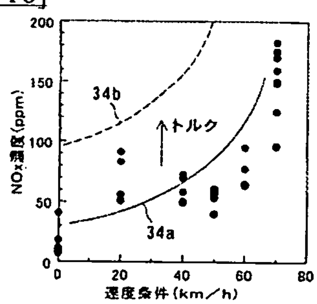

[Translation done.]